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VOL. 8.] DECEMBER, 1935. [NO. 1

EDITORIAL.

IN this number of the Journal Mr. B. E. V. Parham contributes an interesting and important article dealing with disease in the yangona crop which is found growing in many small areas adjacent to Suva.

The yangona plant and some of its varieties are described and details are given of a general survey made with reference to the incidence of disease which shows that some 2,000 acres are under the crop in the Suva district.

The probable source of the disease is traced, its nature is outlined and its present incidence is described as well as its effect on the plants while the seriousness of the disease is emphasised in discussing the economics of the crop as affecting the Indian small holder.

Practical measures of control are indicated and inspections are shown to have been inaugurated with a view to the eradication and destruction of diseased plants, a matter fraught with much difficulty in the wet weather which has been experienced during the last half-year.

A short article dealing with a method of preparing copra along the lines generally adopted in the Far East is included in this issue as an indication of the possibilities of improvement of the quality of the commodity as produced in this Colony at the present time.

The continuously inclement weather which has prevailed during the past six months stresses the advisability of utilising artificial drying methods provided that they can be applied economically and it is claimed that the simple type of kiln described in this article should supply an outstanding need in this Colony.

The first of a series of articles dealing with the soils of Fiji, as far as present investigations have been carried, is contributed by Mr. Blackie who indicates briefly the methods in general use in the examination of soils by the Chemical Division of the Department of Agriculture.

In addition, the same author describes the composition of the alluvial soil found over most of the Central Agricultural Station and indicates that, though it is difficult to work under certain weather conditions, it is a soil of fair average fertility.

A résumé of the work of the Entomological Division of the Department should prove interesting reading especially to those who still recollect the ravages caused by pests in the main coconut areas. The work, briefly narrated, definitely shows that valuable results have accrued as a result of the many investigations made into means of checking the major pests of Fiji and reflect much credit on the investigators enumerated in the text.

The Veterinary and Entomological notes touch lightly on several matters of practical importance so that they should prove of particular interest to readers.

The Government Entomologist makes brief mention of two common fruit flies found in Fiji and of the economic possibilities of the distribution of a parasite which was recently introduced from West Africa by way of Hawaii, as a means of reducing fruit fly attacks on citrus fruits grown in this Colony.

The economic potentialities of the mahogany tree in Fiji are stressed in a short note based on reports, emanating from London, on a sample of timber of this tree grown locally and should prove worthy of notice.

An interesting note regarding certain incompatibilities in citrus stocks is contributed by Mr. Surridge as indicative of the interest which is now being taken in this particular crop which should prove remunerative now that good stocks of approved strains are available within the Colony principally to develop planting material for general distribution.

The exhibit staged by the Department of Agriculture at the recent Fiji Show is briefly described. The description indicates the comprehensive nature of the exhibit and the amount of work involved by the staff in staging it.

WILT DISEASE OF "YANGONA."

By

B. E. V. PARHAM, M.A.
Assistant Agricultural Officer (Pathology).

DURING the past two or three years losses due to disease in the yangona crop (*Macropiper methysticum*) have caused increasing concern among growers and land holders in the Suva–Rewa districts. The search for a good cash crop which might produce a fair return within four or five years has led many growers to take up land in this area for the purpose of growing yangona. The result has been a very great increase in the extent of yangona cultivation in this part of Viti Levu. The spread of disease has, however, been marked and in view of the value of this crop, the following observations are placed on record—following a detailed survey of the affected areas.

THE PLANT AND ITS VARIETIES.

The yangona plant is a robust somewhat succulent shrub, frequently attaining a height of 10–12 feet. The stems arise from the crown at ground level, and in the early stages are branched; but as the stem matures the lateral branches fall off leaving the characteristic nodal scars, so that at maturity the plant appears to consist of a number (10–20) of separate unbranches stems, arising from an extensive base or crown. The leaves are simple, cordate, entire, green or tinged with purple and are also caducous in acropetal succession. Flowers are rarely if ever to be found.

The underground portion of the plant is usually swollen, semi-woody to succulent, giving off numerous lateral fibrous roots.

The portions of the plant of commercial value are:—

1. *Lewe-na* the thickened underground portions of stem and crown.
2. *Waka-na* the lateral roots and rootlets.
3. *Kasa* the nodes of the stems are sometimes peeled and sold mixed with "Lewena" as an adulteration.
4. Peelings of roots and stems have also been sold in the market at a cheap rate.

VARIETIES.

Seemann (1865) mentions six varieties of the plant; but up to the present only five have been found, two of which are not very common. These are:—

(*a*) *White varieties.*—(1) Kasa Leka; (2) Kasa Balavu (Yalu); (3) Qolobi.

(*b*) *Black varieties.*—(1) Kasa Leka; (2) Kasa Balavu.

These are distinguished mainly by their habit, by the length of the internodes (Kasa) and by the size of the leaf-scars.—

(1) *Kasa Leka* (*white*).—Stem about 1½–2 inches in diameter. Leaf scars broad (1 inch), close together, *i.e.*, internodes short (2–2½ inches long). Stem green speckled with transverse lenticels, very abundant.

(2) *Kasa Balavu.*—Stem slender 1½ inch at nodes, ¾ inch at internodes. Leaf scars—small depressed ½ inch in diameter, internodes long 5–10 inches. Stem pale green, lenticels linear, vertical dispersed.

3. *Qolobi.*—Stems more slender, only 1¼ inch at node, ¾–1 inch at internode. Leaf scars ½–¾ inch, internodes long 3½–4 inch. Stem green, lenticels few, punctate confined frequently to the upper portions of internodes. Ratio between diameter of node and internode very marked of order 1 : 2.

4. *Kasa Leka* (*Black*).—Stem green black, scar 1 inch diameter. Node /internode ratio 2 : 3. Internodes 3–5 inches long. Lenticels dispersed circular to transverse.

5. *Kasa Balavu* (*Black*).—Stems very slender, black. Internodes 9–12 inches or more in length, 1 inch diameter or less. Scar ½–¾ inch node/internode ration 2 : 3. Lenticels linear and vertical.

There seems little doubt but that the white varieties are the source of the best yangona, but they take longer to attain maturity. The black varieties are not favoured by the Fijians, and are said to give a poorer beverage, but owing to the fact that plants mature earlier they have been extensively grown by Indians and others in commercial plantations. Black yangona is said to mature (for market purposes) in two and a half to three years, whereas the white varieties cannot be dug before four years. Also there is a possibility that the black varieties are more resistant to disease although the evidence of field records is not definite on this point.

METHODS OF CULTIVATION.

Originally used only for Fijian ceremonial purposes the yangona plant was formerly grown in small plots or around native house foundations and received the greatest care. It was usual to plant the sets or "kasa" (*i.e.*, sections of mature stems bearing nodes) in nurseries first, the young plants being transplanted when a few inches high. This method is still practised commonly among the Fijians.

In commercial plantations, however, the usual procedure is to lay the sets in the prepared hills, cover them with a wisp of dry grass or leaves and allow them to shoot in situ. Some Indians do, however, occasionally plant out from nurseries.

Formerly being treated with special care in small isolated plots, the yangona has in recent years been subjected to the methods incident to mass production and large areas have been planted, especially by Indians and Chinese, in many cases without sufficient attention to soil or other requirements of the crop.

A rich soil and good drainage are essential. The land chosen is usually well drained hillside, preferably new land, and in the area under consideration the soil is frequently shallow and overlies soapstone. The best soil is the

black to chocolate-brown soil which naturally supports a fairly heavy jungle vegetation, the red lateritic soils being unsuitable. A great many yangona plots are at present planted on old banana lands or on land which has already borne one crop of yangona. If two successive crops are taken off the same land the second is very poor. Fallowing for three years or longer has been stated to give satisfactory results.

Land, after clearing of jungle, is ploughed or dug over with forks and the yangona planted in hills six feet apart, two or three sets to a hill. The land is kept free from weeds by constant cultivation or hoeing. The crop is finally weeded when three and a half years old after which nothing is done until the crop is harvested. Dalo (*Colocasia antiquorum*) is commonly interplanted with yangona during the first year.

COST OF PRODUCTION.

The economics of the crop are not easy to assess definitely, but the following summary is made from much independent information. Usually the holding is worked by the owner (Indian) and his family who live on the land and require very little outside assistance. The actual costs in such a case are:—Initial outlay on 10-acre holding:—

Payment to Fijian owners	£10–£20
Deposit (Survey fees, &c.)	£10
Clearing at £3 per acre..	£30
Rent at 10s. per acre	£5 per annum

Thus, for a four year period the total actual cost of production is regarded to be £100 (£10 per acre). Initial outlay £50–£60, rent £20, labour £30.

The return in four years is expected to amount to £500–£600, giving an actual profit of £400–£500 on a 10 acre holding over the four year period.

Side line crops are grown which, after the first three months, are sufficient to keep the man and his family and pay for labour working on the yangona crop. The procedure with Punjabis (whose aim is to earn sufficient profit to return to India) is to take up the land and grow for four years to maturity, then sell out. The buyer assists with harvesting the crop and in return the vendor assists him to plant a second crop.

The following figures on production costs of a commercial plantation at Kandavu are of interest. The cost of production is placed at £30–£35 per acre for a four years crop and the yield should be 20 to 25 sacks per acre (140 lb at 8d. or £4 13s. 4d. per sack) *i.e.*, £93 per acre. A very good crop would give 30 sacks per acre and the fibrous roots (waka) should pay for the cost of digging and cleaning the crop. The best prices in 1933 for yangona were up to 1s. 4d. per lb.

Frequently, in good land, the yangona crop is interplanted with " dalo " during the first year, and the latter is stated to give a cash return (gross) of up to £35 per acre, which offsets the cost of the yangona crop (£30 per acre).

VALUE OF CROP AND PROFITS DERIVABLE.

The value of yangona crops and holdings have been much affected during the past year by the adverse effect of disease and a poor market so that it is difficult to determine the profits derivable under more normal conditions.

It is stated on good authority that yangona in the field is worth £60 per acre whilst Chinese growers estimate that it costs £15 to £20 per acre to clear land and plant the crop.

Losses due to disease have been investigated and it is found that plantations are affected by disease at all stages, and that those which have been so seriously affected as to cause abandonment, involve a complete loss. In other cases, on the first signs of disease the crop is immediately dug

and sold, usually at a loss. It is definitely established that landholders are abandoning their plantations owing to disease, although they could still make a living by growing vegetables. For instance a 14 acre holding, formerly valued at £400–£500, is now estimated as valueless and has been abandoned.

MARKETING.

Yangona is prepared for the market by scraping or peeling the roots and underground basal parts and drying them in the sun. Diseased portions are usually cut out, but generally a good amount of the semi-decayed root may be seen on drying benches.

The market is a local one, the price being 6d. to 9d. per lb at the present time. The fibrous roots may fetch 3d. per lb one plant producing as much as seven pounds of these. A good root many produce 10 lb of "Lewena" the best quality yangona. In 1933, a bundle of "Wakana" the second quality, weighing 20 lb was worth 18s., but now fetches only 1s. 8d. In the same year the bark and scrapings giving a very inferior product were marketable at 6s. to 7s. per bag. The peeled nodes of the stem ("Kasa") have also been sold mixed with the proper root.

It is commonly stated that yangona made from diseased root is deleterious to health and that the selling price of yangona in the market has been affected by this as many growers mix the diseased root with the sound in order to dispose of it.

AREAS SURVEYED.

In the course of the survey the following areas were inspected carefully:—

(1) *Suva–Rewa Road.*—
  (*a*) Four-mile peg and through to Princes Road.
  (*b*) Kalabo village and environs.
  (*c*) Tamavua District.
  (*d*) Nine-mile peg and surrounding areas through to Princes Road (Kalabo Indian settlement).
  (*e*) All the area between Suva–Rewa Road and the sea coast.
(2) *Princes Road.*—All plantations on both sides of road to 13 mile peg.
(3) Naitasiri District and Indian plantations on Baulevu Road.
(4) Districts of Navuakece, Lomaivuna and Navuakese.
(5) Namosi Province and part of Serua.

In the Suva–Rewa Road districts 320 plantations were inspected, comprising an area of 1,288½ acres and these were certainly representative of that area. Of the holdings inspected 293 were Indian, 21 Chinese and six Fijian, all located along both roads and in the intervening areas. The following is a summary of the plantations recorded:—

No.	Locality.	No. of holdings.	Area in acres.		
			Total.	Killed by disease.	Damaged by disease.
1	4-mile Suva–Rewa Road to Princess Road *via* Caubati	46	157½	23	Prevalent
2	Princes Road to 13-mile	29	157	32	..
3	Kalabo and Environs	33	111½	54	..
4	Suva–Rewa Road Southwards	56	104½	3	2
5	9th-mile areas	73	404	74	77
6	4th-mile Suva–Rewa Road, West ..	51	219	56	21
7	Kalabo to 5-mile Princes Road. ..	32	134	10	13
	Total	320	1,288½	252	113

It will be seen that plantations in all parts of the district were affected, that out of a total area of 1,288 acres at least 252 acres of yangona were destroyed and 113 acres recorded as more or less heavily diseased. This means that approximately 30 per cent. of established plantations are affected by disease, representing a monetary loss of something like £12,000.

It is significant that many small areas (from one to five square chains in extent were recorded as healthy, whereas in larger areas disease was invariably present, often to a marked degree. Over the whole area the Black types showed a slightly higher degree of resistance than the white varieties.

Particular note was taken of the alleged recovery of diseased plants. Frequently plants which have been killed back do shoot again from the diseased crown, but these secondary shoots are weak and unhealthy and do not persist. The percentage of such recoveries is certainly very small.

OBSERVATIONS ON THE NATURE OF THE DISEASE.

There are two manifestations of the disease, and among growers there is some doubt as to which indicates the true nature of the disease. In young plants there is a collapse of the stem and definite wilting, in old plants the disease is most marked by a dying back of the stems from the apex. This latter condition has led to the supposition that the disease is one of ultimate branches and leaves, *i.e.*, a "dieback." Careful observations in the field, however, prove that this condition is secondary to the infection of the root stock and crown, and that the disease is a "wilt" caused by the cutting off of the water supply resulting in the subsequent failure of the leaves and ultimate shoots. Thus, in large plants, where the "dieback" condition is the most prominent external feature, the underground portion of the plant is found to be in an advanced stage of decay. In small plants, up to six months old the disease manifests itself definitely as a "wilt" disease, resulting in a loss of turgidity and the collapse of the stem at ground level. In such cases there is usually to be seen a black necrosis about ground level, possibly in cases indicating the infection centre of the pathogen.

The progress of the disease in the field is progressively eccentric, and on slopes frequently from higher ground to lower. The distribution of diseased areas is discontinuous, the demarkation being definite. For example, one side of a gully may be completely devastated and the other side remain quite healthy, the line of demarcation being the watercourse at the bottom.

In young plantations, the incidence of disease is frequently dispersed and sporadic, suggesting that it is carried in the planting sets. On careful inquiry it was found that the earliest and most diseased areas were those planted with sets obtained from Lami, where owing to the presence of disease, the price of planting material was lower than elsewhere. Many independent records were made of the facts (1) that the disease first appeared at Lami in a Chinese plantation; (Ching Chi) and (2) that the worst areas at the nine mile, Princes Road and elsewhere were those planted with sets from Lami. It is certain that the stems of diseased plants were and are being used for further plantings and that these stems are infected with the pathogen.

The disease is now well known to all Indian and Chinese growers throughout the area under discussion, but no record of its appearance earlier than 1932–33 could be found. Many Indian growers were found on being visited a second time to be voluntarily removing and destroying diseased plants as advised.

Careful note was made of the soil type, drainage and related factors which might have a bearing on the incidence of disease. The growth of plants is certainly retarded in poor soils, but the disease was as prevalent in the best soils as in the poorer soils. The wilting of young plants was commonly quite severe in newly cleared forest soils where the growth of healthy plants was exceptionally good. The yangona planted on the shallow soils, often in beds heaped up on the bedrock, is usually stunted in growth but not more subject to disease. The ecological conditions most suitable for this crop do not appear to have been studied, as from the history of its cultivation it is obviously particular in its soil and climatic requirements and not adapted to the extreme conditions of open cultivation. The growing of yangona in pure stands of extensive area provides the optimum conditions for the development of disease and for its subsequent rapid spread.

CAUSE OF THE DISEASE.

Further studies of diseased material have indicated that the primary cause is a wilt producing bacterium. Apart from the cultural evidence, the disease has many characteristics of a bacterial wilt, the pathogen being capable of living in the soil, in which case the *Fusarium* and *Neocosmopara* also recorded would be secondary and possibly saprophytic in nature. This essential point is being studied further as also the method of infection and whether the pathogen is a wound parasite or otherwise.

CONTROL MEASURES.

Possible control measures have already been indicated, and the fuller survey of the affected area only emphasises the necessity for them. From an agricultural and plant-pathological point of view protection of this crop is urgently needed, as there is ample evidence that the disease is a major one.

As far as is at present known the disease has not spread beyond the Suva–Rewa and Lami areas, its incidence in other parts of the island is not marked and not epidemic in character. Disappointed growers are said to be moving out to Tailevu Province along the Transinsular Road and there is every possibility that they will take the disease with them in planting material. Practical plant quarantine measures are not possible but planters in the outer districts should make every effort to secure their planting material from clean areas.

It is still possible to control the spread of the disease by compelling the eradication of diseased areas prior to abandonment and by encouraging the rogueing of diseased plants from all plantations, and the selection of planting material from healthy stands only. It would also be advisable for a time at least, to discourage (if not prohibit) the planting up of large areas of yangona except under supervision as to source of planting material and subsequent care of plantations.

A brief article on the disease and its control was prepared and translated into Fijian and Hindustani for distribution among growers and inspections were inaugurated with a view to stimulating the eradication and destruction of diseased plants.

CONCLUSION.

It is possible from information obtained to form the following conclusions:—

(1) The report describes the results of a survey of yangona plantations in the Suva–Rewa Road areas with special reference to the incidence of disease.

(2) The yangona plant and some of its varieties are described, methods of cultivation, costs of production and value of the crop discussed.
(3) The disease has been known for the past two years, being first noticed at Lami.
(4) The probability is that the disease is not an absolutely new one, but has come into prominence in recent years with the great increase in the areas planted to yangona. A similar trouble has been recorded as appearing at Kandavu.
(5) In the Suva–Rewa districts it is only recently that it has appeared in serious proportions.
(6) The trouble is definitely increasing in established plantations and rapidly makes itself felt in newly planted areas.
(7) Complete destruction of a plantation is not uncommon the average loss from disease without reference to age of crop is 30 per cent.
(8) Plants are affected at all stages, complete losses are experienced in young plantations, but areas up to 2½ years old have been more or less severely affected.
(9) There is no obvious correlation between soil and incidence of disease.
(10) Costs of growing the crop are given as £30 per acre on the average.
(11) Under present circumstances the growing of yangona is probably not commercially profitable in the diseased areas, owing to losses due to disease and poor market price.
(12) A total area of some 2,000 acres has been recorded in the Suva–Rewa–Princes Road areas, 1,288 acres of which has been specifically inspected in the course of the present survey.
(13) The nature of the disease is discussed, its probable cause and possible control measures.

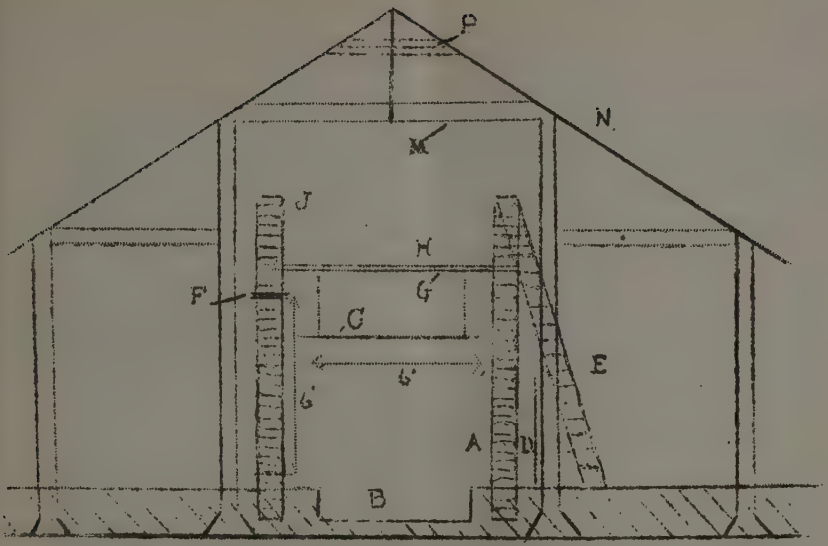
BRIEF NOTES ON SMALL COPRA DRIERS.

By
H. W. JACK, M.B.E., B.A., D.Sc.
Director of Agriculture.

TOURS of selected coconut areas in this Colony together with examinations of copra exhibited at the recent Fiji Show clearly indicate that local customary methods of copra curing fall far short of perfection.

Too much dependence is placed on sunshine as a drying force in a Colony where the rainfall, though not unusually heavy for the Tropics, is unusually prolonged in its distribution, greatly reducing the amount of sunshine available for copra drying and rendering the drying process not only too prolonged but too erratic for the production of good quality produce.

A number of Estates have, of course, long since realised the necessity of utilising artificial heat, but in many instances such heat is not used effectively, the drying frequently not being thorough and in some instances, being too rapid and resulting in case hardening and even scorching of the product. Moreover, many of the driers are expensive to construct in these days of competitive prices for copra, even if they produce good quality copra.



Section of 6' x 6' x 6' Copra Kiln and covering shed and store. Capacity about 600 nuts per curing.

A. Walls of kiln, made of bricks, mud, planks or wattle bark etc.
B. Fire pit excavation 9" deep, for burning shells only.
C. Baffle plate (suspended) with numerous 2" holes to distribute heat uniformly
D. Door into fire chamber. Should fit well.
E. Steps up to copra drying platform.
F. Smoke escape.
G. Beam, iron or wood, to support drying platform.
H. Drying platform. May be laths, iron ribs, expanded metal, wire netting, bamboo, etc.
J. Copra draught shield of brick, wood, iron etc.
M. Structure for closed store which should be draught-proof.
N. Roof. (Grass, atap, corrugated iron or tiles).
P. Roof ventilation at ends of shed - not much required.

Note:- If the side walls of the kiln can be built so that the top is a little narrower than the bottom, hot air circulation will be improved.

While the method of curing described in this article is written primarily with a view to improving the quality of small holders' copra the same method can be equally well applied to large Estates, using larger kilns of the same design or batteries of four or six or more such kilns housed under one or more roofs, as they are on many of the Estates in Malaya and Ceylon where a better quality article, commanding a better price, than that produced in Fiji is normally prepared.

The driers described below depend on clean hot air derived from the burning of cleaned and well dried shells and to obtain a supply of these, husking the nuts before splitting is necessary and is the usual practice on all large and small holdings in Ceylon and Malaya. In those countries the husking is usually done at contract rates at a very low figure, a day's task being approximately 1,500 nuts including splitting and placing them on the drier. It may be mentioned that many hundreds of Indian labourers in the East often husk between 2,000 and 2,500 nuts daily, and Fijians locally easily do 600 in three hours. It may be mentioned that the average nut in Fiji is materially smaller than the average of Malaya.

For small holders, driers six feet by six feet by six feet high capable of dealing with the produce of 20 acres, are recommended while for larger areas or for several cultivators up to an aggregate of 100 acres, kilns twelve feet by twelve feet by six feet high are sufficient. An allowance of 1½ square feet for each acre of cultivation and 20 nuts per square foot is the maximum that can be thoroughly cured at a time.

The walls of these kilns in Malaya are built of a variety of materials, mud. brick, mud reinforced by sticks or rough grass or wire netting, planks, coconut stumps or stones, with the chinks completely filled with puddled clay or cement or other materils to prevent escape of heat. Bricks are the handiest and most durable, but all the other materials give equally good results. *The essential is that the building material should retain heat and radiate it uniformly*, hence galvanised iron alone would not be satisfactory though it has been used in combination with an external wall of mud. A brick wall 12 or 15 inches thick has given the best results. Clay walls have the defect of cracking after a time and need constant repair, but also give excellent results. The best clay kiln is one composed of 80 per cent. heavy clay plus 10 per cent. sand plus 10 per cent. lime, after thorough puddling.

Other alternative materials in Fiji would include coral rock, mixtures of coral sand and clay, "canec" board, jungle stumps cemented with mud and coral sand or any other materials. It is an improvement if the top of the kiln is made slightly narrower than the base to promote circulation.

The shell fires should be sunk in an excavation nine inches deep to shield them from draughts and to give protection to the walls if they are made of inflammable materials. A few small smoke escapes, say one inch high by six inches long should be left in the walls just below the copra platform. The baffle plate to distribute the heat evenly—may easily be made by cutting a number of two inch holes in a flattened sheet of corrugated iron (say seven holes per square foot) and should be suspended about four feet above the fire. (See diagram).

The drying platform may be of four inches expanded iron covered by wire netting, but bamboo or wooden laths fastened firmly to stout cross beams will prove useful and cheaper than iron unless some local scrap yard should perchance provide the iron; stout beams placed two feet apart and covered with half-inch mesh wire netting have been found satisfactory, as have slender iron rods covered by wire netting. The drying copra should be shielded from draughts by a continuation of the brick wall or of a plank wall for 18 inches above the copra platform.

It is most important that the whole kiln be enclosed in a building to exclude draughts effectively so that the humid air over the copra is kept warm and so that heat efficiency is maintained while a very little ventilation at the top of the building is necessary to permit the escape of saturated air. The building or shed which should have doors, also serves the purpose of a store for copra, bags, shell for fuel and unripe nuts which must be matured.

It must be realised that for the preparation of high quality copra, *drying must be continuous and uninterrupted,* and slow drying is preferable to rapid drying—any interruption in the drying process will tend to affect quality detrimentally.

Also *only fully ripe brown nuts should be used* and they should not be split until just prior to the commencement of the drying, any nuts with germination *"apples" more than* $1\frac{1}{2}$ *inches in diameter should be discarded.* Only *dry shell free of fibre,* should be used so that it will burn freely with practically no smoke and it is advisable to store a fair quantity of dry shells ready for use.

If good sunny windy weather prevails, it is a good plan to sun-dry for the first day, placing the split nuts (after draining off the milk for an hour) so that the meat (still in the shell) will get the full sunshine. The same evening the copra must be placed on the kiln and a shell fire started using half shells cupped into each other and placed in a continuous line in the form of a "U" in the fire pit.

As the size of the shells varies considerably in different areas, the number of half shells, placed as indicated in the previous paragraph, which will burn for a given period of time say, six or eight hours or ten hours, must be ascertained by experiment in each district. This is important as the number of half shells used regulates the times of curing and the periods when attention must be given to the fires, although sufficient attention should always be available to see that the fires burn slowly and continuously.

The fires the first day (or night) should burn for 10 hours. The kiln being then kept closed to maintain the heat until morning when the half nuts require to be mixed or turned over.

Unless very favourable weather is experienced it is usually better to begin fire curing at once after draining the split nuts rather than resort to sun curing for the first day.

During the second and third day the heating is continued by making a single row fire as above described, during the day time, or if the weather is warm by merely maintaining the warmth in the kiln until three or four o'clock in the afternoon when a double row of shells is lighted and kept going for 10 hours or so. On the morning of the third day the shells are removed from the copra which is turned over in the process and on the morning of the fourth day a single shell fire, as on the first day, should again be lit as by this time a double fire might tend to char the copra surface.

Needless to say the store and the sacks should be kept clean and periodically inspected for insects. It may be mentioned that shell fuel consumption averages one whole shell for every two nuts converted into copra under Malayan conditions, which are not very unlike those in Fiji, but that fuel consumption will vary greatly according to precautions taken to keep out all draughts so that the heat may be maintained within the kiln.

With good precautions it should frequently be possible to avoid firing for spells of three or five hours provided that the temperature of the copra on the kiln does not drop below 50° Centigrade.

The diagram shown illustrates a six feet by six feet by six feet high kiln (800 nuts) on the lines described. A kiln of twelve feet by six feet by six feet high or twelve feet by twelve feet by six feet (1,500 and 3,000 nuts respectively per curing) may be constructed on exactly the same lines and further information or details which may be found necessary or desirable can be supplied by the Department of Agriculture.

Kilns of the type described have produced first class quality copra in Ceylon and Malaya for many years and can confidently be recommended, especially if built of brick (bricks may be available on the spot if suitable clays are found) which lasts for many years.

One local objection will be the necessity for husking nuts in order to provide shell fuel, but this has not been found difficult or expensive in the East and should not be difficult here once labourers become accustomed to husking.

The cost of construction of a kiln depends largely on the availability of suitable materials but six feet by six feet by six feet kiln should not cost more than £5 and one six feet by twelve feet by six feet high should not cost more than £25 under most local conditions. In addition to the kiln, there is the cost of its housing which is a necessity, as already indicated above, and its cost would again naturally vary considerably according to the availability of supplies of suitable materials.

Should the kiln be constructed of sawn timber or logs as many are in other countries, it is advisable to place a low protecting band of corrugated iron around the inside to minimise chances of firing the walls of the kiln.

It should be mentioned that slow drying at low temperatures is the rule in Ceylon and Malaya and most Estates prolong the drying process over a period of four days, some, however, stop after three days while others continue for five days.

It may be of interest to add that a small kiln of the type described has been erected at the Central Experimental Station at Nandūruloulou (where it may be seen by appointment) and that some first class copra produced on it was exhibited at the recent Agricultural Show held in Suva.

A few selected Native Field Assistants will be trained in this method of production of copra at the Central Agricultural Station, with the object of posting them in coconut producing districts where they will endeavour to instruct Fijians and others accordingly.

It matters little what the kiln is made of provided that it fulfils the required principles of regular uninterrupted uniform drying free from draughts, cold spots, unnecessary smoke and excessive heat. If these principles are assured, then cheapness of construction and upkeep should be the guiding factor.

If there are any matters which are not made clear in this memorandum, the writer will be only too glad to provide further explanations.

SOIL INVESTIGATIONS.

PART I—OBSERVATIONS ON METHODS.

By
W. J. BLACKIE, M.Sc., F.N.Z.I.C., A.I.C.
Government Chemist.

It has been recognised for some time that more complete information in regard to the soils of this Colony is required.

Between 1916 and 1919 soil investigations were carried out by C. H. Wright, a former Agricultural Chemist, and his work is recorded in *Bulletin* No. 9 "Soils of Fiji" and in *Bulletin* No. 11 "Alluvial Soils of Fiji." His work deâlt with alluvial soils in relation to the main rivers of Viti Levu and with soils collected from other localities. No attempt however was made at a general classification.

An attempt was made in 1933 by the Government Chemist (*Annual Bulletin of Divisional Reports* 1933) to classify the soils of the Colony. This however, was only a preliminary attempt using Wright's information, a few field observations in 1932 and 1933 and chemical values determined in 1933. Further information obtained in 1934 together with the appearance of the Geology of Viti Levu by Dr. Ladd, indicates that this classification will have to be modified.

Agricultural development work demands an adequate knowledge of the soils of the Colony and any scheme of that nature must of necessity be prefaced by soil examination and soil mapping, particularly in the more settled portions of the Colony.

With the exception of a few isolated areas and Wright's work on the Alluvial Soils, no systematic study of the soil along modern lines has been made. It is therefore necessary to perform elementary work involving (1) a classification of the main soil types, (2) a determination of the physical and chemical properties of these main types, and (3) a determination of the manurial requirements of our crops on the main soil types. Bound up with work along the above lines are the problems of erosion and the reconditioning of the poorer soils.

In order to increase the efficiency and value of the work it was considered that the investigation of methods would prove a useful preliminary step for the following reasons:—

1. Owing to trained staff limitations it is essential, in order to tackle soil problems seriously, to choose rapid reliable methods which are simple enough to lead to good results in the hands of trained lay staff.
2. Tropical soils are, as a rule, peculiar and methods which are satisfactory under temperate conditions are not always reliable with tropical soil. This is well exemplified in the multiplicity of new methods which have been developed during the last five years, *e.g.* basic exchange and chemical availability methods.
3. Great developments have taken place in soil methods with the result that soils judged from the older standpoints should now be subjected to tests of the new requirements.

The following methods of examination from the standpoint of classification have been provisionally adopted for Fiji soils:—

ON ALL SAMPLES.

1. Hydrogen on concentration by colourimetric technique.
2. Lime requirements by the Hutchinson and Maclennan method.
3. Mechanical analyses by the Sudan sedimentation method, with slight modifications.

4. Humus content by the Sudan ammonia method.
5. Total phosphate by the Lorenz method, modified to deal with a hydrochloric acid extract.
6. Total potash by the modified cobaltinitrite method or the perchlorate technique.
7. Available phosphate by the Lorenz method in a citric acid extract.
8. Available potash by the cobaltinitrite method in citric acid extract.
9. Nitrogen by the Kjeldahl method or the recently introduced phenol. disulphonic acid method.

In certain localties profile examinations are made with a view to the determination of—

1. Exchangeable bases by the method of Rice-Williams.
2. Inorganic colloids by the Tamm's oxalate method.
3. The Silica to Alumina ratio in the clay fraction of the mechanical analysis.
4. Type of minerals and extent in the sand fraction.
5. Carbon by wet combustion methods.
6. Mineral characteristics of parent rock.

EXAMINATION OF METHODS.

The methods used in conducting the more frequent processes required in a soil laboratory may be briefly discussed with advantage.

Hydrochloric Extraction.—The conventional manner of preparing a hydrocholoric acid extract is to take 25 grams of dried and pulverised soil and leave it in contact with 200 cc. of hydrochloric acid of specific gravity 1·115 for 24 hours on a boiling water bath. After cooling, the material is diluted, filtered and washed to bring the volume of the filtrate up to 500 ccs.

A considerable quantity of acid is used in this procedure, so that it is considered advisable in the interests of economy to cut down the quantity, accordingly only 10 grams of soil, and 80 ccs. of acid are now used and the filtrate is made up to 200 ccs. The concentrations are the same, and if care is taken in sampling there is no danger in using the smaller quantity of soil.

It is not convenient under local conditions to keep soil and acid on the water bath for a period of 24 hours. The procedure is accordingly modified to keeping the soil and acid in contact for a period of three days, five hours each day being at the temperature of the boiling water bath. Extracts made in this manner are not greatly different chemically from those developed in the normal manner and have the advantage of a saving of acid.

Citric Acid Extracts.—It has been the practice to determine available phosphate and potash by 1 per cent. citric acid extraction of the soil by the original Dyer technique. In attempting to save time use is made of a rotating shaker devised from a bicycle wheel with beer bottles attached as containers. It is found however, that quantities have to be reduced since each bottle is only capable of holding 500 ccs. and the use of several bottles in extracting the one soil introduces repetition of several operations. The original technique is now modified by the use of $1\frac{1}{4}$ per cent. citric acid concentration and this modification appears to give results similar to those obtained by mechanical shaking using 1 per cent. citric acid. Ten samples can be carried out at the same time under existing working conditions and the acid solution is left in contact with the soil for seven days, each container

being shaken thoroughly once every hour during the working day. The quantities used are 250 grams of soil, 25 grams of citric acid and 2000ccs. of water. The amounts of available plant foods are small and therefore it is considered that no attempt should be made to cut down the quantities in order to take advantage of a shaker. As in all soil work the main consideration is the absolute reproduction of technique so that all values may be comparable.

Hydrogen ion concentration.—Owing to the absence of electrometric equipment, the hydrogen ion concentration is determined by the colourimetric process using Gillespie's drop ratio method. Extracts of one to five on clay soils' and one to three on sandy soils are used and the extract is cleared by centrifuging. In difficult cases the collodion sack method of securing a clear filtrate is adopted. The soils of the Colony are mainly of an acid nature free calcium carbonate being almost always absent. Acidity of the main soils, shows the following fluctuations:—

Alluvials	.. 5·4 to 5·9 Ph.
Lateritic soils ..	.. 4·9 to 5·4 Ph.
Soapstone soils ..	.. 6·0 to neutral.
Red brown soils ..	.. 5·5 to 6·0 Ph.

Lime Requirement.—The Hutchinson and Maclennan method of assessing the lime requirement has been adopted owing to the fact that with Fiji soils the indication shown is fairly well correlated with the actual lime requirement. The actual requirement on the wet side of Viti Levu is between 2 and 3 tons per acre, on the lighter soil, and up to 5 tons or more on the more acid soils of Suva.

Mechanical analysis.—Mechanical analyses carried out by the Robinson Pipette method, although simple and rapid in the hands of the Chemist, lead to erratic results with the type of native staff available in a tropical Chemical laboratory. In this method it is essential to get complete dispersion; without this the subsequent technique, however careful, is useless. It is, therefore, advantageous to use sedimentation methods and the beaker method, as practised in the Sudan is now adopted.

It is found however that complete dispersion cannot always be obtained by the normal sodium carbonate procedure by shaking or puddling, but that a preliminary boiling with 0·2 per cent. sodium carbonate yielded good comparable results.

The following technique has therefore been adopted: Five grams of the fine over-dried earth are thoroughly puddled with 5 ccs. of 0·2 per cent. sodium carbonate solution. The volume is increased to 75 ccs. and the suspension brought to the boil and maintained at boiling point for three minutes. The suspension is then transferred to the sedimentation beaker with 0·2 per cent solution of sodium carbonate and brought up to 250 ccs. to the depth of 10 cms. in the containing vessel. After 16 hours the suspension is poured off and remade with 0·05 per cent. sodium carbonate solution. This and subsequent sedimentations are alternately of eight hours and over night duration. After the fourth subsidence, puddling with a camel hair brush using 5ccs. of 0·2 per cent. sodium carbonate solution is carried out. Most of the clay is washed out in from four to eight days; after the clay has been removed and its amount determined by difference in the usual way, the silt is separated by a deposition of the remaining soil for a period of four minutes, 19 seconds, the normal temperature being in the neighbourhood of 25° C. The settling time of seven and a half minutes adopted by the Sudan method is too long for tropical temperatures and leads to low silt values. After drying the residue from the clay determination the soil

becomes slightly caked, necessitating a little working with a camel hair brush, before sedimenting for the silt value. The fine sand is separated from the coarse sand by sieveing in the usual manner.

No preliminary acid treatment is required with Fiji soils owing to the absence of calcium carbonate, also the percentage of organic matter is low with the result that the soil is not subjected to the hydrogen peroxide treatment. In any case it is impossible to keep hydrogen peroxide for long under tropical conditions. As with the Sudan method, the values are determined on the oven-dried basis. This technique has yielded good results in the hands of a native assistant who can carry out from 15 to 20 samples a week and still have time left for general routine. It is proposed when time permits to carry out a comparison with the Robinson technique.

Careful microscopic examination of the fine sand and coarse sand fractions indicated that clay and silt are effectively removed. The following results obtained by a native assistant show the accuracy to be expected:

Sample No.	Clay.	Silt.	Fine Sand.	Coarse Sand.
Koro No. 1	24·6	4·8	68·6	1·8
Koro No. 1 (repeat) ..	23·5	5·3	68·4	2·6
Navuso No. 1	16·1	12·2	57·3	14·3
Navuso No. 1 (repeat new sample)	15·0	15·9	53·1	16·0
Navuso No. 2	23·4	9·6	58·3	8·6
Navuso No. 2 (repeat new sample)	23·3	11·6	57·8	7·3

Humus.—At the moment from the point of view of simplicity the humus content is determined by the ammonia method which appears to give low but comparable results. Values of one to two per cent. are usually obtained for the Rewa alluvials by this procedure.

Total Phosphate.—The official method for the determination of phosphates gravimetrically takes much time and the volumetric method is not altogether reliable and it is considered that the Lorenz method 1901 modified by Neubaur in 1912 and used extensively in Germany and Austria should give quicker results.

In the case of the official method the precipitation of the phosphate as ammonium phosphomolybdate and then as magnesium ammonium phosphate introduces liability to error. Also in soils where phosphate is low the precipitate may be effected to a considerable extent by traces of impurity.

The bulky Lorenz precipitate has a distinct advantage over the pyrophosphate weighed in the official method. The factor for the Lorenz precipitate to phosphate is ·03295 and the magnesium pyrophosphate to phosphate is ·5379. That is, for a given weight of phosphate, the Lorenz precipitate is approximately 18 times that of the pyrophosphate. A difference of one milligramme in the former is equivalent to ·05 milligrammes in the latter. This is of distinct advantage on poor soils containing low available phosphates, the quantity of which obtained by the official technique would almost be negligible. The advantage of the Lorenz method from this point of view is apparent.

It is usual in the Lorenz technique to determine the phosphate from a nitric acid extract of the soil. This is not convenient owing to the fact that the recognised official extract is with hydrochloric acid and it is impossible to determine phosphate by the Lorenz method directly on the hydrochloric extract, owing to the high concentration of chlorine ions.

Nitric Acid extracts of the soil have been made and the phosphate determined by the A.O.A.C. and Lorenz methods. Hydrochloric extracts of the same soil contain more phosphate, as indicated in the following table:—

Soil.	Extract.	Phosphate by Lorenz methods.	Phosphate by official meth.
Vatulele 1	Nitric acid extract as for Lorenz meth.	0·66	0·70
„	Repeat	0·66	0·70
„	Hydrochloric acid official method ..	...	0·83
„	Repeat	...	0·85

The Table indicates that the Lorenz method gives reproducable results of the same order as the official method but that the official hydrochloric extract contains more phosphate than the Lorenz nitric acid extract.

Hence it is deemed advantageous to make hydrochloric acid extracts of the soil according to the official method and to determine the phosphate by the following technique.

(1) Total phosphate. Fifty ccs. of the hydrochloric extract are evaporated on a hot plate to a volume of about 5 ccs., 5 ccs. nitric acid are then added and evaporation is continued to near dryness. A further 5 ccs. of netric acid are added and evaporation is continued to complete dryness. The residue is dissolved in 20 ccs. of nitro-sulphuric acid regeant and warmed to effect complete solution, when 20 ccs. of water are added, the material filtered and the basin, residue and paper washed with 10 ccs. of water. The concentration now corresponds with the dilute nitro sulphuric acid medium of Lorenz and the phosphate is precipitated directly from this medium in the normal manner by the special Lorenz precipitating agent. Excellent results are obtained.

Available phosphate.—Two hundred ccs. of citric acid extract where available phosphate is 0·01 per cent. are evaporated to a small volume in an aluminium basin on the hotplate. The residue is transferred to a siliea basin and evaporation continued to dryness with the addition of 0·5 ccs. of nitric acid just before final evaporation. The residue is strongly ignited (preferable in a muffle furnace) dissolved in nitro sulphuric acid and the phosphate determined as described under total phosphate.

Several attempts were made to determine the phosphate in the citric and hydrochloric extracts of the soil by the Molybdenum blue colourimetric technique which is more rapid than the Lorenz method. Unfortunately it has been found that Fiji soil extracts fade so rapidly that accurate comparisons were not possible and hence the method has been abandoned.

Potash.—It has been the practice in Fiji to determine the potash on the hydrochloric and citric acid extracts by the perchlorate technique. The method in the hands of a trained chemist gives accurate results, but has the disadvantage of being rather long.

It was therefore considered worth while to experiment with the sodium cobaltinitrate method of G. Milne (J. Agr. Sc. 1929, 19,541), modified to prevent retention of potash by Ferric oxide. The method is entirely satisfactory and with colourimetric technique is extremely rapid. The green solution is very suitable for colourimetric comparisons and provided traces of silica are removed by filtration, there is no difficulty in making an accurate colour comparison. It is very essential to keep the cobaltinitrite solution in a dark bottle and it is advisable to make up requirements for a month only.

SOIL INVESTIGATIONS.—THE SANDY LOAMS OF THE CENTRAL AGRICULTURAL STATION.

By
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Government Chemist.

In the Annual Report of the Government Chemist for the year 1933 it was mentioned that the soils from the Central Experimental Station, adjacent to the river bank, were of sandy loam type—but that they showed no evidence of bedding in the manner normal to alluvial soils and displayed an even texture to a depth of at least nine feet.

A profile examination which has been made in the drain bordering banana block No. 3 at the river end and to a depth of nine feet, revealed additional information shown in the table below:—

Zone.	Colour profile.	Depth profile.	Acidity as Ph.	Total phosphate.	Available phosphate.	Total potash.	Available potash.	Fine sand.	Coarse sand.	Silt.	Clay.
				%	%	%	%				
A. Top Soil ..	Brown-black ..	2′ 6″	5·9	0·126	·013	·31	·012	53·4	3·1	21·6	21·9
A1 Sub soil ..	Brown . ..	1′ 6″	5·9	0·132	·012	·40	·016	56·8	7·1	17·3	18·8
A2 Sub soil ..	Light-brown ..	1′ 6″	5·9	0·101	..	·37	·018	62·0	3·5	19·0	15·5
B. Sub soil ..	Brown . ..	3′ 6″	5·9	0·118	·008	..	·064	51·0	5·5	25·2	18·3

Nitrogen content Zone A=0·177 per cent. Zone B=0·112 per cent.

Similar water relationships were indicated throughout the profile and the impression was formed of a fairly compacted type of soil more of the nature of a heavy loam rather than a sandy loam as indicated by the mechanical analysis.

The soils of the station are peculiar in possessing a high fine sand content with similar clay and silt values. They are, at times, difficult to work this difficulty when dry being ascribed to their peculiar mechanical composition.

From the chemical standpoint these soils appear to contain an abundance of plant food in a readily available condition and despite the heavy rainfall of some 140 inches per annum there is little evidence of extensive leaching or washing down of the finer particles. Available phosphate decreases with increase of depth of the profile whereas the available potash increases with a well marked zone of accumulation at B (below 5 feet 6 inches).

The horizons of Zone A are determined more particularly by colour changes and there is no visible evidences of lateritisation.

The soils on account of their high potash content and physical features, would appear to have been derived more particularly from the sandstones, tuffs and marls of the Suva series and to have been laid down at the mouth of the river or in shallow water near the mouth. Subsequently it is estimated that they were elevated and cut through by the water system of the present Rewa river.

The soils of the station can be improved mechanically by green manuring, liming and constant working when weather conditions are favourable. Their chemical composition is entirely satisfactory although they would probably respond to phosphatic fertilizers.

The chemical findings in regard to these soils are well correlated with actual field trials. Excellent crops of bananas (where they escaped disease), and cane having been grown on these soils in the past.

SUMMARY RECORD OF ENTOMOLOGICAL WORK IN FIJI.

By
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Director of Agriculture.

Economic entomology in Fiji can be said to have commenced with the appointment in 1905 of C. H. Knowles as Superintendent of Agriculture. This officer, although not himself an Entomologist, recognised the losses due to insect agency and the difficulties attendant upon their control by cultural methods when dealing with native populations, and early turned his thoughts to biological methods in dealing with these problems. There is no doubt that much of the phenomenal success which was later attained in this direction was greatly facilitated by Knowles' early work and researches.

In 1909 Mr. F. P. Jepson was appointed Government Entomologist, and this officer carried the work on considerably further, working out the life history of many insects and being particularly interested in those species connected with the transmission of disease.

A year after his appointment Jepson was sent to Hawaii for a month to study the work which was being carried on in that Group. Arising out of this mission, and through the good offices of the Hawaiian Sugar Planters' Association and the United States Department of Agriculture, the Mexican seed destroying fly *Agromyza lantanæ* was successfully introduced into Fiji against the weed, *Lantana camara*. Jepson also introduced Top Minnows from that country into Fiji where they are now locally abundant and prove useful as predators of mosquito larvæ.

In 1911 Jepson visited Samoa to investigate the results arising from the disastrous introduction of the Rhinoceros Beetle *Oryctes rhinoceros*, into that Group and to evaluate the menace thus threatening Fiji.

In 1913 he made another overseas trip, this time to Java, in search of natural enemies of the banana borer, *Cosmopolites sordidus*. He introduced the predatory beetle, *Plaesius javanus* thence into Fiji and although many years elapsed before any definite results were evident, from this introduction it is now widely distributed over Viti Levu and is known to be doing good work. With the outbreak of the European war overseas missions were necessarily curtailed, and it was not until 1919, when H. W. Simmonds came to Fiji, that this method of attacking problems was resumed.

At this time four major problems were facing agriculture in Fiji:—

1. The scale *Aspidiotus destructor*, then called the banana scale, had spread to the coconut districts with disastrous results.
2. The coconut leaf moth, *Levuana iridescens*, annually destroyed practically the whole of the coconut crop on Viti Levu.
3. The melostomaceus plant, *Clidemia hirta*, had become a weed of such magnitude as to be called "the curse."
4. In the Lau and drier parts of Vanua Levu a leaf mining beetle, *Promecotheca reichei* swept like a fire through the coconuts at intervals of some years.

So serious were these problems that it was proposed to offer a reward of £5,000 to anyone who would bring either No. 2 or No. 3 under control and one officer was actually engaged at a salary, expenses and the offer of the reward if successful in controlling No. 2.

With regard to the first of these problems, in 1919 Simmonds was invited to undertake a special mission to Tahiti to introduce a Chalcid reported by Doane as having done excellent work in controlling the scale *Aspidiotus destructor* in that Group. On arrival, investigation revealed that two para-

sites were attacking this scale in Tahiti, viz. *Aspidiotiphagus citrinus*, Craw, and *Aphelinus chrysomphali*, Mercet. The latter was successfully transported and soon spread throughout Viti Levu, doing valuable work. There is, however, reason to believe that it was actually already present in Fiji, on Taveuni, at the time of the introduction, where it was living on another species of scale, *Chrysomphalus dictyospermi*; *Aspidiotus destructor* not at that time having reached that island, and thus the presence of this natural enemy in Fiji was unsuspected. The other species landed in very small numbers, and it was found advisable to reinforce the colony, and a second trip was undertaken again by Simmonds in the following year. Both these insects did good work, but although greatly reduced in intensity, the pest continued to spread to new areas, and further work became necessary some years later.

The coconut leaf moth (*Levuana iridescens*) had been known for perhaps 40 years, during which time it had been confined to Viti Levu. In 1922 Simmonds observed that the coconuts on the Island of Caqalai were badly diseased and investigation showed that it was due to this insect, which had also reached Moturiki. In doing this it had bridged the gap separating Viti Levu from the Lomaiviti Group and thus threatened the whole coconut industry of Fiji. Whilst the pest was only known from the one island of the Viti Levu Group there were a number of reasons for assuming that it was an introduction and that could its original home be discovered it would be found to be closely controlled by parasites.

In the hopes of discovering this original habitat Knowles had instituted enquiries, and ascertained the presence of another related insect with similar habits in Malaya where it was reported to have many enemies, both insect and fungus. Opinions, however, differed as to the probability of parasites of the Malayan insect attacking the Fijian species, the more so that they belonged to different branches of the *Zygænidæ*. Simmonds was therefore instructed to search for the original home of *Levuana* and, to that end, spent eight months in 1923, working through New Guinea, the Bismarcks, Solomon and New Hebrides Groups. Although many new coconut insects were discovered and much of interest ascertained, no trace of the feeding marks of this or any allied larvæ were observed.

In 1924, Mr. Despeisses, then Superintendent of Agriculture, engaged A. M. Lea, Government Entomologist of South Australia, to search for the pest in the New Guinea region, failing which he was to proceed to Malaya and endeavour to introduce the parasites of the above mentioned allied moth, *Artona catoxantha*. After spending some time in the Torres Straits district, Lea proceeded to Malaya and Java, from which latter, he made two attempts to introduce parasites of *Artona catoxantha*, both proving unsuccessful.

Meanwhile, in view of the serious spread of the pest, Dr. Tothill, a Canadian Entomologist, had been appointed to take charge of the work, and he was accompanied by Messrs. R. W. Paine and T. H. C. Taylor, two Entomologists from England. These latter remained for a month in Hawaii, en route to Fiji, in order to study the methods adopted in that country.

With the failure of Lea's attempt to introduce the parasites of *Artona* from Java, Simmonds was despatched to Kuala Lumpur (Malaya) to await another outbreak, with the aim of renewing the attempt, using, however, different methods. On arrival in Malaya no big outbreak was in progress, but sufficient material was discovered at Batu Gajah to work out the life cycle of certain parasites. Simmonds was joined by Taylor who was instructed to assist with the investigations of what then appeared to be *Artona*

under normal control. Shortly after Taylor's arrival a major outbreak was reported and from this outbreak parasites were collected in immense numbers, transferred to 85 coconut seedlings growing in kerosene tins placed within 17 specially made very fine wire gauze cages and railed to Singapore for shipment to Fiji in charge of Taylor. Although some 20,000 larvæ of the *Artona* had been shipped, only 315 parasites *Phychomyia remota* reached Fiji alive in August, 1925.

From these 315 parasites, colonies were bred in large numbers and distributed to make one of the most spectacular successes of entomological history, the *Levuana* pest being still completely under control as a result of this valuable work.

With the control thus obtained against *Levuana* the scale *Aspidiotus destructor* assumed the position of the most serious enemy with which the coconut grower had to contend. In certain parts, particularly Moturiki, the east coast of Ovalau, and the Wainibokasi region of Viti Levu, this pest had, prior to the introduction of the Tahitian parasites, caused the complete loss of the crop. Although these imported parasites had greatly improved the position in certain parts, particularly in Ovalau, the pest continued to extend its range, reaching Vanua Levu and eventually Taveuni. In the latter island, however, a highly efficient control had already been established in Fiji before the arrival of the pest. With the object of checking the virulence of the insect Taylor introduced several other internal parasites from Java. No benefit can be said to have followed this introduction and he was despatched to Trinidad where Urich had reported two ladybirds as doing good work against the pest in that country. Taylor discovered several additional predators and successfully imported five ladybirds into Fiji. Curiously only one of these, *Cryptognatha nodiceps*, proved of any great value in its new home, but this was so successful that the scale is to-day closely controlled throughout Fiji, so closely that its other enemies have almost disappeared.

Whilst this work was in hand, Paine was engaged in endeavouring to establish a number of natural enemies of another coconut pest *Tirathaba trichogramma*, which Taylor had shown to be a causal agency of serious premature nutfall. This work entailed two visits to Java and occupied a number of years, but he was eventually successful in establishing throughout the Group a series of parasites attacking the pest at consecutive stages, with present indications of definitely increased yields.

Meanwhile Simmonds carried out important investigations with a cotton pest and succeeded in showing that a brown stain of the lint which was causing trouble was due to the mechanical action of attack by the bug *Tectocoris lineola*. It may be possible to reduce the numbers of this pest should cotton become an important industry in Fiji, but for the present this work is not being continued.

The same worker demonstrated the probability that flight was a major factor in the spread of the banana borer and also evolved a method of obtaining clean planting material from infected stock by soaking in fresh water for 21 days.

In 1927 Simmonds was sent to Honolulu to obtain a colony of the lantana bug *Teleonemia lantanæ*, which had been introduced into that island by Koebele. Through the kind assistance of the officers of the Hawaiian Sugar Planters' Association this mission was successfully accomplished and the bug is now well established in Fiji. It has, however, in this Group become subject to predatory enemies and its value against the weed is hampered by the long wet spells which are of frequent occurrence, though during dry seasons good results are apparent.

Meanwhile the melostomaceus weed *Clidemia hirta* had become so prevalent that it became commonly known as "the curse." Knowles had already located the original habitat of the pest as Central America and the West Indies, and in 1921 Simmonds sent drawings and material to the Department of Agriculture, Trinidad, in the hopes of obtaining some agency to hold it in check. Arising out of these requests attention was given to the plant, and Urich discovered the thrips which now bears his name, *Liothrips urichi*. When Taylor was in Trinidad collecting ladybirds to control the scale he was instructed to investigate the position and as a result of preliminary investigation, reported favourably upon the insect. As a consequence, a student, Cook, was instructed to investigate the matter further. This officer whilst not discovering any objectionable habits in the insect placed a low value upon it as a control. Despite this, in view of the rapid spread of the weed it was decided to introduce the thrips, the work being entrusted to Simmonds who proceeded to Trinidad.

Shortly after arrival in Trinidad it became obvious that other and more powerful agencies than the thrips were preventing the spread of the weed in that country, and the presence of a number of previously unsuspected seed-destroying agencies was discovered. Despite this it was considered that the thrips was, in the first instance, the most desirable for introduction to Fiji, since it actually destroyed the plant, not merely the seeds. The insect was successfully introduced and achieved a remarkable success over large areas, where useful herbage has now replaced the weed. As, however, the thrips does not thrive under close shade and in certain other special conditions the introduction of one or more of the seed destroying agencies might still prove of economic value.

The coconut leaf mining beetle pest *Promecotheca reichei* which was normally confined to the drier portions of the Group was next given attention, for although subject to several parasites, its ravages frequently led to the entire loss of the crop over considerable areas.

In Java and Malaya the allied *P. cummingi* was known to be well controlled and Taylor was therefore despatched to Java to attempt the introduction of one or more of the natural enemies existing in that country. In this work he was entirely successful and by the introduction of the Chalcid *Pleurotropes parvulus* the coconut industry in Fiji had demonstrated three spectacular entomological successes.

In this connection a tribute must be paid to the technique evolved by Taylor who made an artificial leaf mine with microscope slides in order to handle these Chalcids, also to an equally ingenious method of removing the ovaries of the parent fly and distributing the eggs, which was devised by Paine, for the mass breeding of the Tachinid *Erycia basifulva*, a parasite of *Tirathaba*.

Whilst the above résumé covers the major operations of the Entomological Division of the Department of Agriculture in Fiji it by no means includes everything. No mention has been made of the successful introduction by Paine of the *Megarhinus* mosquito, nor of that officer's general mosquito work, nor has reference been made to importations of housefly enemies and certain other insects by Simmonds. Enough has, however, been stated to indicate that valuable work has been performed within the Colony although it is not possible to evaluate the work in terms of cash.

There have been disappointments and striking successes and there are still many problems ahead, such as the fruit fly upon which Simmonds is now working and the blue rat tail weed pest of which, when in Trinidad he found the seeds being destroyed by a *Cecidomyiid*. Still, it is a far cry

from the days when the coconuts of Viti Levu were brown with *Levuana* and Moturiki and Ovalau were yellow with scale. The retreat of the "curse" and the removal of the periodic losses due to the leaf miner have all represented solid cash to the country and make one look forward to other successes in the constant struggle between the agriculturist and those agencies which so often deprive him of the fruits of his labour.

FRUIT FLY IN FIJI.

By

H. W. SIMMONDS, F.R.E.S.
Government Entomologist.

MOST fruits in Fiji suffer severely from the attacks of certain insects, chief of which are the fruit flies of the genus *Chætodacus* (Bezzi) and the fruit piercing moth *Othreis fullonica* and its allies. The larvæ of this latter feed on the *Drala*, (*Erythina* sp.) and these trees should be destroyed in the neighbourhood of orchards. Of the fruit flies two species are common:—

(1) *Chætodacus passifloræ*, Frogg. which is endemic and probably peculiar to Fiji. This species attacks guava, citrus, kavika, granadillas, ivi, pawpaw, cotton bolls, sandalwood seed and other fruits.

(2) *Chætodacus xanthodes*, Broun, which occurring also in Samoa and Raratonga may be an introduction and is certainly not so generally distributed throughout Fiji as *C. passifloræ*. It is recorded as attacking granadillas, citrus, guavas, pawpaw and pineapples.

Yet another species, allied to *C. distinctus* of Samoa, has been captured by the writer in Suva, but its habits and distribution are still unknown.

During the past year work in the entomological division has been concentrated upon the two major pest species, *C. passifloræ* and *C. xanthodes*, and some interesting results obtained.

It was found that with the advent of the guava season the numbers of fruit fly maggots in the fruits rapidly increased, despite the attacks of two parasites. This increase was followed by a heavy concentration of the predatory bug, *Germalus pacificus* which sucked the newly laid eggs of the fly, leading to an equally rapid decline in the numbers of the pest until, towards the end of the guava season, all fruit found was quite free from attack.

This freedom from attack lasted six to eight weeks, viz., July–August, when odd guavas were found again to be punctured. Despite this cleaning up in the big guava areas, ripening citrus and kavikas continued to suffer, showing an unexpected localisation of the pest and also that *Germalus*, which normally is abundant and breeds upon *lantana*, does not concentrate on either of these fruits to any extent.

It was found that fruit flies show a definite preference for certain fruits, chief of which are guava (all kinds), kavikas and mandarins.

In view of the fact that both the native parasites, *Braconids* of the genera *Opius* and *Biosteres*, attack the maggots of the fly by piercing them through the skin of the host fruit, they are only able to reach such as are near the surface and those lying deeper within the tissues escape, it was felt that, if a parasite could be obtained which entered damaged fruit in search of its prey, valuable results might be attained.

Such a parasite suggested itself in the Eulophid, *Tetrastichus giffardianus*, which had been introduced from West Africa into Hawaii against the Mediterranean fly, *Ceratitis capitata*, Wied. and, through the courtesy of the United States Department of Agriculture and the Matson Line, a small colony of this insect was successfully imported. These took kindly to both species of Fijian fruit flies and bred up rapidly in the laboratory, the original ten increasing to about 12,000 in four months. Colonies of the new introduction are being distributed about the Group as rapidly as possible and have been recovered on the Rewa–Suva road, where a parasitism of 20 per cent. by this species has already been obtained. It remains to be seen to what extent it will be able to bridge the period of host fruit scarcity July-October, but the present indications are distinctly hopeful and, it seems probable, that, if an appreciable reduction can be attained in the fly population early in the guava season, there will not be the numbers about when the citrus commences to mature and that this fruit, which is seasonal in character and, not the most favoured host of the pest, may to some extent at least be protected from attack.

THE MAHOGANY TREE.

By
H. W. JACK, M.B.E., B.A., D.Sc.
Director of Agriculture.

At the end of last year Mr. H. W. Simmonds, Government Entomologist drew the writer's attention to the two mahogany trees (*Swietenia macrophylla*, King) growing at Nasinu and arrangements were made to have one large fork lopped and sawn into planking, of which a sample was polished and despatched to the Imperial Institute London for favour of examination and report.

The trees referred to are now some 23 years old are growing in poor soil and one has a girth measurement of some eight feet at the base while the other shows almost equal growth but was forked at the base (until cut).

It was one of the forks of the latter tree which was lopped, seasoned, and sawn into planks to give the sample which was polished and forwarded to London for examination as to its commercial value as a timber. The timber polished to a light brown colour and local contractors maintained that it " worked " excellently.

In a detailed report which has been received from the Director of the Imperial Institute, he states that the sample planks were examined with much interest by the Institute's Advisory Committee on timbers and surprise was expressed at the rapid rate of growth of the tree from which the timber was cut.

The Committee regarded the grain of the timber as somewhat irregular but on the whole the timber was considered promising and the Acting Chairman of the Committee (Mr. J. P. Fraser) who had much experience of the mahogany trade undertook to examine the specimens and report thereon.

Mr. Fraser duly reported on the sample boards and recommended the planting of the tree generally in Fiji. In his report he stated that the sample pieces were " exceptionally wild in growth and rather defective

but seeing they have been cut from a tree only 18 years old, I am not at all surprised. Candidly I think it is wonderful that a tree only 22 years old can produce boards of this size" and "in spite of the wild grain the sample pieces have planed up well so that there is really nothing fundamentally defective in the flowery grain."

He also pointed out that at present mahogany was rather out of fashion but emphasised his opinion that mahogany would again come into vogue and hold the market for about 20 years when there would be "bound to be a demand for wood of curly or wild grain as well as for straight grained timber" and that he was "unhesitatingly of opinion that there would be a good market in the United Kingdom."

His report finished with the assertion that Fiji "should certainly plant up large areas with the wood looking forward with considerable confidence to the future, always provided, of course, that the land is cheap and the cost of planting is reasonable."

The Director of the Imperial Institute in his covering report states that timber of the same species of mahogany grown in Ceylon was examined previously by the Institute and that the results of working trials were entirely satisfactory and, moreover, that the Timbers Committee were of opinion that there would be no difficulty in marketing timber of equal value. Similarly in 1931, Madras grown timber of this species examined at the Forest Products Research Laboratory in England indicated that the actual quality of the timber compared reasonably well with native grown Honduras mahogany.

In notes received from the Imperial Institute, it is pointed out that considerable success has been obtained with the cultivation of this species of mahogany in India, Ceylon, British Guiana and Trinidad and that the trees had shown remarkable rates of growth. Annual girth increases in Ceylon and India of 1·7 to 2·5 inches had been recorded as well as girth measurements of over eight feet for trees up to 39 years old.

In British Honduras two systems of planting mahogany have been employed. In the first system the mahogany is raised by the natives in the maize fields, seed being sown in nurseries and the seedlings when five to six months old being planted out at distances of 10 by 10 feet in the standing maize which affords cover during the first year of growth. Thereafter the mahogany is sufficiently established to compete with secondary growth which invades the clearing and quickly closes the canopy. "Thinnings are not saleable so that closer spacing is unnecessary and in any case, the preservation of a mixed canopy for soil protection all the year round is considered desirable" (Kinloch *The Methods of Regeneration of Mahogany in British Honduras*).

The second system concerns the restocking of cleared areas. In a paper on the *Cultivation of Mahogany in British Honduras* by Oliphant (British Empire Forestry Conference 1928) he states that the most favourable environmental conditions for the establishment and development of young mahogany are those prevailing in second growth in cleared areas. In such areas seed is dibbled or seedlings are planted concurrently with or after harvesting a crop of maize. He further maintains that in a regeneration of existing forests an ultimate stock of 40 trees to the acre is sufficient and the advantages of groupwise distribution may make it worth while to reduce the concentration still further.

Numerous published accounts indicate that mahogany thrives well on a variety of soils (alluvial, lateritic, &c.) as long as they are moderately well provided with humus and normal plant foods. The trees demand a fair amount of light but will stand moderate shade; they do not coppice

well and are sensitive to mechanical damage and fire. Young plants stand transplanting well and the general rate of growth is rapid. The chief pest recorded as being destructive to the species is the shoot borer (*Hypsipyla grandella*, Zell.) which enters the terminal bud of the leading shoot and causes the stem to fork, thus preventing the formation of long clean boles, but this pest has not yet been found in Fiji according to the records of the Government Entomologist (Mr. H. W. Simmonds). In Trinidad, attacks by this pest appear to be avoided by raising the seedlings in moderate shade in the forests and then gradually reducing the shade over a period of four years.

In the same Island, Urich reports that the West Indian Mahogany is highly resistant to attacks by *Hypsipyla* as compared with the Honduras species (Bull. Imp. Institute, June, 1935,) and hence mahogany seed has recently been imported from Trinidad rather than from British Honduras.

It is understood that several leading personalities in Fiji have seen the few mahogany trees, now 23 years old, growing at Nasinu and in these notes an endeavour has been made to indicate the potential value of this tree in the regeneration of local forests where they have been stripped of all their timber of commercial utility.

Furthermore, the planting of this and other suitable timber trees, which require some shelter in their young stages, should prove useful in the reclamation of waste lands now occupied by guava, lantana and other useless shrubs which form such a large aggregate area in Fiji.

It is hoped that this brief note will stimulate some interest in the value of this tree and that it may be made possible in the near future, to give practical effect to the suggestions which are put forward.

VETERINARY AND ANIMAL HUSBANDRY NOTES.

MAIZE FOR WORKING ANIMALS.

By
C. R. TURBET, B.V.Sc., M.R.C.V.S.
Senior Veterinary Officer.

During recent visits to cane growing districts it was seen that working stock of the great majority of small cane farmers were not being kept in good working condition. The cause of this was that supplementary feeding was not being practised. The horse, or any animal for that matter, cannot be expected to work really well unless he is fed well. Probably the best concentrate feed available to cane growers is maize.

Apart from the question of animal husbandry farm economy enters prominently into this discussion, since one of the difficulties of the small agriculturist in Fiji is to find satisfactory money crops as opposed to those crops which are grown for food. Formerly maize was largely grown and provided a very satisfactory crop for small farmers. A fairly constant market was available in the sale of maize for the feeding of large numbers of horses used on plantations controlled by the Colonial Sugar Refining Company Limited and other Companies. Maize constituted the chief concentrate ration for their working horses and bullocks and every year large quantities of maize were purchased for this purpose.

There was a period a few years ago when it appeared that horses would be substituted in agriculture by tractors and, of course, that would mean the absolute loss of that avenue for the disposal of maize. More recently, however, it has been found that horses are more than holding their own against the tractor for agricultural purposes in Fiji, but on the other hand, the large European controlled estates have almost ceased to exist. Horses are not now stabled in large stables under expert management, instead the large estates have been replaced by many small farms owned and worked chiefly by individual Indian cultivators. These people maintain their own animals for agricultural purposes. At present their animal husbandry is not good and except in a few cases no attempt is made to feed a supplementary ration to their working animals. There are probably more animals engaged in agriculture to-day than ever before, but for the above mentioned reason the consumption of maize by working animals has fallen off tremendously. The Indian cultivators were the chief maize producers; their market was to European controlled plantations; now these Indian cultivators are the plantation owners and except in a small way they are neither growing maize nor buying it for horse feed. By their failure to supply a better ration to their working animals they are thus destroying their chief market for maize. If this folly could be pointed out to these people and if they could be encouraged to go in for greater supplementary feeding of their working stock not only would the condition of their horses improve, with resulting better work, but also a greatly increased market would be created for the disposal of their maize and this crop once more would become a satisfactory money crop.

This Journal probably never reaches the Indian agriculturist, but there are many people who read the paper who are in close contact with them and if through these people Indian cultivators could be exhorted to feed a better ration to their working animals, better work and increased consumption of maize would result.

Maize cultivation should be as formerly, a chief crop of those small farmers not dependent on cane cultivation. Their chief market for maize should be to cane growers.

HIDES FOR EXPORT.

By
C. R. TURBET, B.V.Sc., M.R.C.V.S.
Senior Veterinary Officer.

Practically every vessel which leaves for Australia carries away a small consignment of hides. That these shipments are remunerative is evidenced by the fact that one seldom hears the export of hides discussed, evidently it pays the shippers and that is the end of it.

The collection of hides for export, however, is not well organised and there should be a considerable increase in the number exported. It appears that the butchery businesses have their business well organised for the export of hides derived from their slaughter houses but it is not in respect of these that complaint is made, but more particularly in respect of hides derived from cattle killed on plantations.

On an island like Taveuni for instance there must be at least 20 head of cattle killed per week. Apparently all these hides are wasted. It is suggested that exporters of hides should establish agencies in country districts for the collection for export of hides of plantation killed cattle.

Furthermore, statistics indicate that some £2,600 is annually spent in this Colony on the import of leather for local purposes while in addition the imports of manufactured leather goods exclusive of footwear amounts annually to approximately £5,000. These figures would indicate that there should be an opening in Suva for a small tannery.

PIG SUPPLIES IN SUVA.

By
C. R. TURBET, B.V.Sc., M.R.C.V.S.
Senior Veterinary Officer.

Now that pig breeding for the supply of pork to the various butcheries in Fiji is being better organised, the time is drawing nigh when the local market will be fully supplied by pigs bred in Fiji. This is as it should be.

It appears, however, that certain breeders in anticipation of supplying this market have entered into contracts with the butcheries for the supply of pork. Anticipating that the supply will soon be more than is required, local buyers have established the practice of issuing contracts to the producers. In one instance a contract has been given far in excess of what the supplier is at present able to supply with the result that it has been necessary for this particular supplier to import pigs from overseas to fulfil his contract, whilst on the other hand some local producers are unable to sell pigs because they have no contract.

This state of affairs does not appear to be in the best interests of the farming community and it is suggested that producers should get together with butchers and come to some workable arrangement which would ensure that all producers have an opportunity of participating in the local pork market to obviate the necessity of having to import pigs from overseas for slaughter.

TUBERCULOSIS IN SWINE.

By
H. M. STUCHBERY, B.VSc.
Veterinary Officer.

Although in the routine of meat inspection in Fiji it has always been notices that tubercular lesions are fairly common amongst pigs that have been reared locally, it has been assumed that most of the affected animals have incurred their lesions through the ingestion of infected milk. While this is still true of the majority of tubercular infected pigs in this country, it was found in one piggery that direct infection was apparently the means of the spread of the disease. At this piggery it was reported early in 1934 that heavy losses were being sustained among the swine. As it was reported that an imported boar had on post mortem been found to be suffering from severe lesions of tuberculosis this disease was suspected of causing the losses. A post mortem was performed upon another sick pig and again severe lesions were found in this animal. As no milk was fed to this herd and only cooked meat given, it was assumed that the infection must have been spread directly from one animal to another. As the infection seemed to be fairly general it was decided to tuberculin test the remaining breeding sows and segregate the non-reactors from the

remainder of the herd which were as opportunity arose, slaughtered. By these means and a thorough disinfection of the sites, &c., it was hoped that a fairly clean lot of pigs would result.

The test decided upon was the double intradermal test similar to that used in cattle, which test has been regularly used in Fiji for the past four years. The site chosen for the inoculation was a point on the neck about three inches behind the left ear. After clipping the hair from a patch about three inches in diameter, this was sterilized with tincture of iodine and one-tenth c.c. of old tuberculin injected into the deeper skin tissue. After 48 hours a similar injection was given, a final inspection being made about 24 hours later when the nature of the reaction was determined. Where positive reactions occurred it was noticed that the swellings were always fairly large being from 20 m.m. to 70 m.m. in diameter, very painful to touch and rather tense. This latter condition was attributed to the natural firmness of the skin in this region. Another feature noticed was that the majority of reactors appeared quite indisposed while undergoing the test, many of them refusing to take food. No such indisposition occurred amongst non-reactors. It was also noticed, especially in white coated pigs, that the skin above the site of the reaction in positive cases was of a dull brick-red colour. Of this herd, out of the eleven remaining breeding sows, five reactors were detected whilst later on in the year the breeding animals of another herd was tested and of 32 animals, seven gave positive reactions included in which was another imported boar. On post mortem it was found that all these reactors had lesions of tuberculosis.

In May, 1935, after similar losses had been reported from another piggery, it was decided to perform the tuberculin test on these animals. Here again tuberculosis was found to be very prevalent, fifteen reactors being detected out of twenty-nine animals tested.

With the two latter herds, it was found that a similar type of reaction developed as occurred in the first mentioned herd, also the fact that practically all reactors showed definite signs of illness.

In the last mentioned herd, it was reported that the first noticed case of illness occurred in an imported boar which was found to be tubercular on post mortem. As the disease appeared to be so rampant in the latter herd, it was decided to take steps to eradicate the disease. All the non-reactors were therefore separated from the other swine and a separate part of the sty was thoroughly disinfected before these animals were put into them. It was possible to carry out a thorough disinfection as the sties were well built with concrete floors, whilst the superstructures were chiefly iron. The walls, roof and floor were first thoroughly scrubbed down with hot water and cresol. Then a lime wash was applied containing one per cent. cresol, whilst the floors were coated with a thin coat of cement also containing one per cent. cresol. An unoccupied disinfected sty was maintained between the affected and unaffected pigs. The remainder of the pigs (reactors and untested animals) were to be slaughtered at the earliest convenience. Of six slaughtered reactors seen, all had tuberculosis in varying stages.

As these animals were slaughtered the sites occupied by them were to be disinfected in a similar manner to that mentioned previously. It is also proposed to repeat the test six months from the date of the first test in an endeavour to thoroughly clean the herd of tuberculosis.

It would appear that this test is a valuable diagnostic agent for tuberculosis in swine, but it is hoped that in the near future an opportunity will occur to test a number of swine intended for slaughter purposes. By the examination of the carcases of these animals after slaughter, an estimate of the reliability of this test to detect all reactors will be obtained.

PARASITIC INFECTION OF THE LEG AND FOOT OF A DOG.

By
H. M. STUCHBERY, B.V.Sc.
Government Veterinary Officer.

About the end of July a dog was brought to the Veterinary Laboratory with a history of acute lameness accompanied by swelling in the left hind leg.

Examination revealed that there was considerable firm painful swelling of the limb as far up as the hock joint. The dog carried the foot off the ground all the time whilst on its feet and every now and then drew the limb right up to its body as though in acute pain. It was noticed that there were a few pinpoint breaks in the skin between the pads of the foot and just above the foot. It was thought that the condition was a grass seed infection and was treated accordingly.

A few days later the swelling in the limb suddenly became very much larger. The pin point breaks in the skin became much enlarged and discharged considerable pus-like material, whilst the pads of the foot began to slough.

On cleaning up the foot, a worm about eight inches in length was found coiled up in the region under the main pad of the foot whilst another was found lying in the connective tissue at the posterior aspect of the leg. This worm was similar in size and appearance to the previous one.

The dog was destroyed about two days later and a search made for further parasites in the affected region but none were found.

The worm was tentatively identified as the heart worm *Dirofilaria immitis* but this awaits confirmation. The heart worm of the dog is reported to have been occasionally found in unusual regions in the body.

This observation would appear to be the first made in Fiji of the occurrence of a filarial worm in the subcutaneous tissues of a dog.

EXPORT OF HORSES FROM FIJI TO AUSTRALIA.

By
C. R. TURBET, B.V.Sc., M.R.C.S.
Senior Veterinary Officer.

It will be of interest to horse breeders in Fiji to know that horses may now be exported from this country into Australia without quarantine on arrival in Australia. The following are the requirements in the way of certificates which would be necessary to send with the horse:—

(*a*) A declaration by the owner of the animal stating:—
  (i) that the animal has been free from disease during the next preceding six months prior to shipment;
  (ii) that it has not been in contact with any animal suffering from disease during that period.

(*b*) A Certificate by a Government Veterinarian certifying:—
  (i) that the animal is free from disease;
  (ii) that during the six months next preceding shipment no horse, ass or mule was imported into Fiji from any country other than Australia, New Zealand, Great Britain, Northern Ireland, Irish Free State, Channel Islands, Canada or the United States of America;

(iii) that he applied the Mallein test with negative result.

Where the Chief Quarantine Officer at the port of landing in Australia is satisfied that the vessel on which the horse imported from Fiji was carried did not carry any animal between intermediate ports on the current voyage it shall not be necessary for that horse, ass, or mule, to be conveyed to a quarantine station unless the Quarantine Officer suspects that the animal is suffering from a disease.

ANIMAL IMPORTATIONS 1935.

INCREASING prosperity of the Colony is evidenced by the greater number of breeding animals imported in 1935. The following animals have been admitted:—

January	5	1 Berkshire Boar	C.S.R. Company, Lautoka.
May	24	2 Shorthorn Bulls and 3 heifers.	J. L. Hunt, Rewa.
June	19	2 Sows	Leylands, Suva.
„		1 large white Boar	Morris Hedstrom, Suva.
July	6	2 Zebu Bulls	C.S.R. Company, Lautoka.
August	15	1 Friesian Bull, 1 Cow and 1 Calf	A. H. Witherow Esquire, Rewa.
„		1 Shorthorn Bull	Williams, Tailevu.
September	4	2 Sows	Morris Hedstrom Ltd., Suva.
October	9	7 Thoroughbred Mares	D. B. Costello, Suva.
October	14	1 Suffolk Punch Stallion ..	P. Costello, Suva.
November	2	6 Shorthorn Heifers	C.S.R. Company, Lautoka.
December	10	1 Tamworth Boar & 10 Berkshire	
		— Sows	C.S.R. Company, Labasa.

Total, 42 animals.

PRODUCE MARKETING NOTE.

By

A. B. ACKLAND.
Acting Produce Inspector.

EFFORTS are being made to establish markets for various Fijian produce both locally and outside the country and though there are many difficulties to be encountered fair progress has been made with some commodities. Special efforts are in progress to bring about banana sales in bunches as well as in cases and to date this year, 14,062 bunches have been sold in Canada and 1,785 bunches in Sydney. In addition 132,435 cases of bananas have been satisfactorily marketed in New Zealand.

Amongst other products which are being marketed mention may be made of 2,997 cases of oranges, 5,793 cases of mandarins, some hundredweights of tobacco, 6,000 cigars, also kumalas, maize, yams and dalo.

MYCOLOGICAL NOTES—MORTALITY IN LARVAE OF TELEONEMIA LANTANAE.

By
B. E. V. PARHAM, M.A.
Assistant Agricultural Officer (Pathology).

Since the introduction by H. W. Simmonds in 1928 of *Teleonemia lantanæ* for the purpose of biological control of *Lantana crocea*, the high rate of mortality of larvæ and adults has been recorded on several occasions. (Simmonds, *Agricultural Journal* Volume 2, No. 1, 1929).

This mortality has been shown to be partly due to insect predators; and recently another factor has been recorded which may account for a proportion of deaths. In October, 1935, R. Fyfe during his investigations of *Teleonemia lantanæ* found that the final instar larvæ and adults were commonly attacked by an entomogenous fungus which he kindly submitted for examination and determination.

The fungus proved to be a species of *Hirsutella* very similar in general characteristics to *H. citriforme*, Petch, which has been recorded in Ceylon, New Zealand and elsewhere (Petch, *Journal British Mycological Society*).

The parasitised insects are fastened down to the leaves of the Lantana by rhizoidal hyphæ and at maturity the fungus forms a tuft of sporiferous synnemata radiating from the body of the host.

The writer wishes to thank Mr. Fyfe for the opportunity of examining this fungus.

TOMATO WILT.

By
H. W. SIMMONDS, F.R.E.S.
Government Entomologist.

Following upon the notes on this disease published in the last number of this Journal the writer decided to attempt to grow tomatoes in pure broken soapstone. To this end the soil was removed over a given area and the underlying rock broken up, with additional broken soapstone added on top. This was turned over about twice and at the end of six months was considered sufficiently weathered to be used.

A small quantity of superphosphate, about one ounce per plant, was added to the soil and a row of Suttons "Satisfaction" tomatoes planted out. Sulphate of ammonia, one ounce to the gallon of water, was watered in three times during the growing season.

No wilt developed and all the plants gave heavy yields of large size fruit. Whether the absence of wilt was due to the alkalinity of the soil or the absence of the bacterium is, of course, a question, but it offers a means of utilisation of the bare patches of soapstone around Suva, at no great cost.

ENTOMOLOGICAL NOTES.

By
H. W. SIMMONDS, F.R.E.S.
Government Entomologist.

Levuana iridescens, Beth. Bak.—An outbreak of this pest was recorded early in the year, on coconuts growing in the Wainamala Valley. It was quickly suppressed by the introduced parasite *Ptychomyia remote*, Ald.

Promecotheca reichei.—An outbreak of this coconut pest is reported from Vanua Balavu in the Lau Group, but appears to have come under parasitic control.

Teleonemia lantanæ, Dist.—A colony of about 300 of this introduced enemy of lantana was despatched to the New Hebrides early in October, whilst another colony, of about 1,000, was despatched to New Caledonia in November. The latter arrived in good condition.

Tetrastichus giffardianus, Sily.—Colonies of this recently introduced (from Hawaii) fruit fly parasite have been despatched overseas as follows:—

New Hebrides	500	October
Western Samoa	250	November
New South Wales	350	,,
New Caledonia	700	,,

Apanteles tirathabæ.—Small colonies of this parasite of the coconut spike moth *Tirathaba trichogramma* were despatched in October and again, in November, to Apia, Western Samoa.

Nemeritis palmarum.—A small colony of this species, parasitic upon the same pest, was despatched in November to Western Samoa and a second, larger consignment, is now being prepared for shipment.

Papuana lævipennis.—Complaints of damage to taro by the grub of a beetle on Tarawa in the Gilbert Islands proved to be due to the above Dynastid beetle. This species, previously known from the Solomon Islands only, is apparently a recent introduction and is proving a most disasterous pest, completely destroying all taro on the island.

SOME PRELIMINARY OBSERVATIONS ON CITRUS AURANTIUM AS A CITRUS STOCK IN FIJI.

By
H. R. SURRIDGE, A.R.C.Sc.(I).

Citrus aurantium known as sour orange, Seville and Florida sour, is the stock used for the production of more than 75 per cent. of the world's output of citrus fruits. Its popularity is due primarily to its immunity to *Phthiacystis gummosis* and other citrus diseases, secondly to the better quality of fruit said to be produced by scions on this stock. It is in common use wherever citrus is cultivated with the exception of South Africa where, for reasons not yet known, it has proved a failure.

In Fiji, citrus culture is in its infancy, hence the following brief notes are recorded to add to the general knowledge of this orange for stock purposes.

Sowings of seed of *Citrus aurantium* were made in 1933 at the Nasinu Citrus Research Station, of these the best were transplanted into a nursery for subsequent budding.

Buddings of Marsh Grape Fruit and the following sweet oranges:—Nasinu, Valencia Late, Parramatta and Mediterranean Sweet, were made in January, 1934, on to these stocks as well as on to the sweet orange (*Citrus sinensis*, Osbeck) stocks. Growth and maturity differences are striking.

In all cases, buddings on to the sweet stock average six feet six inches in height, are strong healthy trees, but have not shown flowers or fruit.

In the case of the sour stock, no differences are yet observable in the Marsh Grape Fruit.

With the sweet orange buds on the sour stock the following differences appear:—

(1) A tendency to separate into tall and dwarf trees, dwarfs averaging one foot five inches to one foot nine inches according to variety, while talls average two feet eight inches to three feet five inches.
(2) Dwarf trees show yellowing of all leaves, while talls are generally a light green.
(3) Earlier fruiting, fruit and flowers produced on both dwarfs and talls.
(4) Complete incompatability displayed by certain buds, shown by a restricted growth and subsequent die back.

Details are as follows:—

Valencia Late ..	24 dwarf	average height	1 ft. 9 in.	1	fruiting
	39 talls	,,	3 ft. 5 in.	5	,,
Nasinu	36 dwarf	,,	1 ft. 9 in.	2	,,
	16 talls	,,	3 ft. 3 in.	5	,,
Parramatta ..	24 dwarf	,,	1 ft. 6 in.	2	,,
	2 talls	,,	2 ft. 8 in.	2	

It is realised that no inference can yet be drawn from the observations here recorded, but the differences indicate the urgent need for long range stock trials carried to completion before final recommendations can be made. The work of R. Hatton, at the East Malling Research Station, England, with reference to apple stocks is the classical example of the type of work necessary to be undertaken with regard to citrus stocks and its necessity is demonstrated by the experience recorded from the Californian Lemon groves which did not show incompatability of stocks until established some 15–20 years.

FIJI AGRICULTURAL SHOW.

THE D partment of Agriculture, as usual, took a prominent part in the local Agricultural Show which was organised by the Fiji Show Association and was held on the 14th October in Suva.

The Department, in addition, staged an exhibit of general agricultural interest to indicate the various lines of work which were being followed at the time.

The chief feature of the exhibit prepared by the Chemical Division was a collection of the main ores from the Emperor Gold Mine at Tavua which were kindly submitted by the Manager of the Mine.

On the same table the methods adopted in assaying ore samples were displayed and keen interest was shown by the public in this, the latest industry in Fiji.

Included with the agricultural general exhibit were a series of essential oils distilled from local plants grown at the Nasinu Experimental Station, also a small sample of cassava flour and cassava meal for which there are possibilities in the dextrine industry.

The Entomological Division staged an exhibit showing the two principal Fijian fruit flies (living) together with their most important native enemies. Colonies were shown of the newly introduced parasite *Tetrastichus giffardianus* and the methods adopted in breeding these species (host and parasite) in captivity were demonstrat d. Cases we e also displayed exhibiting a series of drawings illustrating the anatomy of the flies.

The Agricultural Division staged several exhibits of which coconuts, tobacco, cotton, various economic plants and food crops were the main features.

In connection with the copra industry the exhibit comprised samples of good and of bad copra judged by standards of marking on points which determine the quality of the copra. A model copra kiln suitable for small holders was also on show and indicated the simplicity of construction required to erect kilns that can, with ordinary, but regular, attention produce excellent quality copra.

In addition a number of the by-products of coconut cultivation were staged, including fibre, fibre rope, matting, charcoal, timber, brushes, oil, dessicated coconut, meal and fresh nuts graded for export.

In the tobacco section, types of leaf suitable for wrappers and for filling cigars were shown as well as a display of cigars made from different tobacco wrapper types. In addition the developing of "stick" trade in tobacco for native consumption was emphasised by a show of cases ready packed and marked for export as well as other open cases to permit of examination of the actual "stick."

As regards cotton, the exhibit consisted of bales of Sea Island and Fiji Hybrid cotton ready for export. Piles of seed cotton, lint, cotton seed oil and meal were staged in addition to a series of cases in which the selection of the chief economic hybrid type was indicated. Combed seed cotton of a number of other varieties were also shown in cases and attracted considerable attention.

Some of the work of the Produce Inspection Division was illustrated by the operation of machine grading of oranges which was in action periodically for the duration of the Show and formed a centre of much interest.

Methods of budding citrus trees was also a feature of interest, the operations being demonstrated frequently on a collection of potted citrus seedlings. Decoration was assisted by a collection of potted flowers, plants and trees which are grown by the Department for sale locally.

General agricultural produce was well represented by bunches of bananas, cased bananas ready for export, tapioca roots and flour, pineapples, yams, dalo, derris roots, paddy, yangona, groundnuts, sweet potatoes, kauri gum, maize and maize flour. Bread made of wheaten flour mixed with 10 per cent. maize flour proved attractive, samples being given to selected spectators.

The Veterinary Division demonstrated a moveable model fowl house and run suitable for Fiji conditions. This embodied the features of being readily transported from one plot of ground to another, sanitary construction and protection of the birds from adverse weather conditions. Notices were placed on the structure indicating its salient features.

A model pig sty was also exhibited to demonstrate a reasonably cheap structure for raising healthy pigs. In addition, the usual exhibit of pathological specimens was on show as well as framed specimens of the grasses of Fiji. Finally the display of concentrate food stuffs available in Fiji with descriptions of their feeding value was also staged.

Officers of the Department assisted in the erection of District and Provincial stalls, with arrangement of the exhibits thereon and with the judging of the various competitive agricultural sections.

In the competitive sections of the Show special mention may be made of the excellency of the winning Provincial Exhibit (Naitasiri) the winning District Exhibit (Davuilevu) and of the copra samples sent in by Estates. With regard to the later, eleven Estates participated and some of the samples were very good while others were decidedly poor indicating that drying had been insufficient. The samples were all judged according to a system of points devised to give proportional weight to the chief factors which affect the quality of copra namely, oil content, moisture content, cleanliness, appearance, acidity and smell.

With the exception of the copra, all the exhibits in the competitive section were entered by Fijians.

THE LANTANA BUG IN FIJI.

By

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Council for Scientific and Industrial Research Commonwealth of Australia.

For some time it has been recognised that, in Fiji, certain environmental factors have been effectively operating against the increase in numbers of the Lantana bug, *Teleonemia lantanæ*. The writer has made an attempt to identify and to evaluate the importance of the ecological factors responsible for limiting the activities of this insect in Fiji before attempting its introduction into Australia.

Observations extending over a period of five years, made by Mr. Simmonds, have shown that there is a marked seasonal variation in the effect of *Teleonemia* on *Lantana*. The bushes are apparently much more heavily infested and more damaged by the bug during the cooler and drier season of the year.

During the warmer and wetter months of the year, *Lantana* appears to be much more lightly attacked, partly because of the fact that during this season the bugs characteristically migrate to and concentrate on the inflores-

cences while during the winter it is the vegetative part of the plant which is attacked. Colonies of bugs feeding upon the leaves cause a much more spectacular type of damage than that caused by the more insidious feeding on the individual florets which leads to a smaller seed production.

In spite of the effect caused by the movement of the bugs from the leaves, it appears that such adverse climatic and biotic factors as are operating, are working with maximum intensity during the summer months.

Of prime importance seems to be the Lygaeid bug, *Germalus pacificus* (Simmonds, this Journal, 1929). While this bug is to be found on *Lantana* all the year round, it breeds up in large numbers in spring when the flowers and fruits become more abundant. It also feeds on the florets and fruits and so comes into more direct contact with whatever *Teleonemia* nymphs are on the flowers during this season.

Teleonemia is attacked in the field under humid conditions by an entomogenous fungus identified by B. E. V. Parham of the Fiji Department of Agriculture as *Hirsutella* sp. Not only are adult bugs attacked but also 5th instar nymphs which likewise succumb to a similar infection. The parasitised insects are first firmly attached to the stems or leaves by undifferentiated hyphal rhizoids which push through between the ventral sclerites of the thorax. Later, bundles of conidiophores, the synnemata, grow out from the dorsal surface. These are white and simple at first but usually become brown and branched with age and extend to a length of approximately 2 cm. if conditions have remained humid.

Other enemies observed actually attacking *Teleonemia* in the field included adult Ladybirds of the species *Coccinella transversalis* and Neuropterous larvae of the genus *Hemerobius*. These predators, however, seemed to be of very little importance on account of their very infrequent occurrence on *Lantana*.

Observations on the effect of heavy rain have shown that torrential rains are responsible for a reduction in the numbers of *Teleonemia* nymphs. The feeding of a colony of bugs on a single leaf causes a yellowing of the leaf accompanied by a response on the part of the plant which leads to the formation of an abscission layer at the base of the petiole. When a leaf bearing a colony is in this condition, the advent of torrential rain leads to a further reduction in the number of bugs by knocking the leaf and the bugs to the ground. Where the bushes are old and the leaves well above the ground the nymphs cannot return to their food and soon die.

In the present state of our knowledge it appears that we have to ascribe the inability of *Teleonemia* to increase in numbers and so increase its range to the following factors:—

(1) The activities of the predatory bug, *Germalus*.
(2) The presence of an entomogenous fungus which is able to develop rapidly under humid conditions and to spread by taking advantage of the gregarious habits of the bug.
(3) The mechanical effect of torrential rain.

The writer has also observed the Lygaeid bug, *Germalus pasificus*, feeding upon the nymphs of two other unrelated insects, vix. *Brachyplatys pacificus* Ball, a small black Pentatomid and a *Pseudococcus* Mealy bug which occurs in small numbers on *Lantana* in the Suva district.

AVERAGE MARKET PRICES IN DECEMBER, 1935, OF PRINCIPAL AGRICULTURAL PRODUCTS OTHER THAN SUGAR.

By
A. B. ACKLAND.
Acting Produce Inspector.

Copra	Suva	£9 10 0	per ton
Rice	,,	16 0 0	,,
Paddy	,,	9 0 0	,,
Taro	,,	3 0 0	,,
Yams	,,	7 0 0	,,
Bananas—New Zealand	,,	4s. to 4s. 6d.	per case
New South Wales	,,	4s. to 4s. 6d.	per case
New South Wales	,,	£0 1 9	per bunch
Pineapples (fresh)	,,	0 2 6	per case
Maize (grain)	,,	0 10 0	per bag
Kumalas	,,	0 6 0	per bag
Kumalas	New Zealand	0 14 0	per bag
Tobacco Leaf	Suva	0 0 6	per lb
Kauri Gum (first grade)	,,	18 0 0	per ton
Cotton, Sea Island	London	0 1 6	per lb
Cotton, Egyptian	,,	0 0 7½	per lb
Pawpaws	New Zealand	0 10 0	per case
Granadillas	New Zealand	0 11 6	per case